CONTRACT INSPECTION REPORT

CONTRACT NO. | TASK NO.

25X

TO:

CONTRACT ADMINISTRATION & SETTLEMENT
BRANCH/PD/OL

DATE: 3 October 1967

INSPECTION REPORT NO. *(If final, so state)*: 2

ESTIMATED COMPLETION DATE: 1 December 1967

NAME OF CONTRACTOR

X1

TYPE OF COMMODITY OR SERVICE

Rear Projection Viewer

THE CONTRACTOR IS ON SCHEDULE ☐ YES ☒ NO

PER CENT OF WORK COMPLETED - 3%

PER CENT OF FUNDS EXPENDED - Fixed Price

THE CONTRACTOR WILL PROBABLY REMAIN WITHIN ALLOCATED FUNDS ☒ YES ☐ NO IF ANSWER IS "NO" ADVISE RECOMMENDATION AND/OR ACTION OF SPONSORING OFFICE, ON REVERSE HEREOF. IF KNOWN, INDICATE MAGNITUDE OF ADDITIONAL FUNDS INVOLVED.

HAS AN INTERIM REPORT, FINAL REPORT, PROTOTYPE, OR OTHER END ITEM BEEN RECEIVED FROM THE CONTRACTOR DURING THE PERIOD? ☐ YES ☒ NO *(If yes, give details on reverse side.)*

HAS GOVERNMENT-OWNED PROPERTY BEEN DELIVERED TO CONTRACTOR DURING THIS PERIOD? ☐ YES ☒ NO *(If yes, indicate items, quantity, and cost on reverse side.)*

INCENTIVES

IS THIS AN INCENTIVE CONTRACT ☐ YES ☒ NO

IF YES, CHECK TYPE

☐ COST ☐ AWARD FEE ☐ PERFORMANCE ☐ DELIVERY

NOTE:
USE REVERSE SIDE FOR COMMENTS.
FINAL REPORT MUST CONTAIN INCENTIVE EVALUATION.

OVERALL PERFORMANCE OF CONTRACTOR

1. ☐ OUTSTANDING
2. ☐ EXCELLENT
3. ☐ VERY GOOD
4. ☒ ABOVE AVERAGE
5. ☐ AVERAGE
6. ☐ MINIMUM ACCEPTABLE
7. ☐ UNSATISFACTORY

IF OVERALL PERFORMANCE OF CONTRACTOR IS UNSATISFACTORY OR MINIMUM ACCEPTABLE INDICATE REASONS ON REVERSE SIDE.

RECOMMENDED ACTION

☒ CONTINUE AS PROGRAMMED

☐ WITHHOLD PAYMENT PENDING SATISFACTORY PERFORMANCE

☐ TERMINATE

☐ OTHER *(Specify)*

IF TERMINATION IS RECOMMENDED OR IF THIS IS A FINAL REPORT PUT COMMENTS ON REVERSE IN NARRATIVE FORM ON CONTRACTOR'S PERFORMANCE AND CERTIFY THAT ALL DELIVERABLE ITEMS UNDER THE CONTRACT HAVE BEEN RECEIVED. THESE INCLUDE, WHERE APPLICABLE, THE FOLLOWING:

ITEM	REC'D	DOES NOT APPLY	ITEM	REC'D	DOES NOT APPLY
PROTOTYPES			MANUALS		
DRAWINGS AND SPECIFICATIONS			FINAL REPORT		
PRODUCTION AND/OR OTHER END ITEMS			SPECIAL TOOLING		
			OTHER GOVERNMENT PROPERTY		

DATE OF LAST CONTACT WITH CONTRACTOR
27 September 1967

SIGNATURE OF INSPECTOR | DIVISION

5X1

NARRATIVE REPORT ☒ INTERIM ☐ FINAL

25X
25X

1. On 27 Sept 1967 the contractor was visited to review the progress on this project. The attendees at this meeting were: [redacted]

X1 2. [redacted] has given first priority to the two-barrel optical system as outlined in the last inspection report. The 3X to 30X zoom range needs the most improvement and the design of the 25X to 70X barrel is almost complete. [redacted] 25X estimates that the probability of success of this design is the highest of all the designs initiated. Schematically, the Low-power system consists of the following:

[redacted]

The high power range is similar with a positive auxiliary added between the film plane and the first zoom element.

3. The design of the two-barrel system with magnification ranges from 3X to 15X and 15X to 70X has been discontinued. It was determined that the design did not offer a high probability of success and would create more operational difficulties than the first mentioned system.

4. The single barrel zoom system design has been given second priority. This system was complicated by its wide angular field of view and its zoom system requirements of f/3; however, attempts will be made to reduce the power of the first auxiliary lens and add three more surfaces to the last negative auxiliary, thereby attempting to correct the aberrations encountered. This approach utilizes a 48 surface optical design program with 6 of these elements within the negative auxiliary.

5. The single zoom system design with switching negative auxiliaries has been terminated. Not only did the design require switching the negative auxiliary, but it necessitates moving the zoom modual itself along its optical axis. The mechanical complexity (indexing) appeared too great and the single zoom design limits the optimization parameters available for aberration correction.

6. The two-barrel in tandem system has also been eliminated. This system would require an approximate four foot increase in viewer length. This system could not be folded and the screen brightness parameters could not be met.

7. The performance of the system outlined in #2 is indicated in Attachment #1. The contractor is forming their spot diagrams by tracing rays from the screen to the object plane and they claim that this method is valid as long as the Raleigh Limit of the spot diagram is property chosen. This limit has been set at 4/f/no. in u.
X1 [redacted] is tracing on axis rays through four points and off axis rays through nine points.

8. Attachment #2 is a Human Factors Study of the [redacted] Viewer performed 25X
X1 [redacted] The items outlined in the study were discussed with [redacted] from an 25X
X1 academic viewpoint and [redacted] was plainly and emphatically instructed not to interpret the discussion as contractual direction and that NPIC would not entertain a change-in-scope as a result of the discussion. The discussion was merely for the purpose of more thoroughly acquainting [redacted] with the operation at NPIC on an 25X unclassified basis. This discussion will also serve as a guide where two alternative methods would solve a problem (at approximately the same cost) one of which would more nearly satisfy NPIC's requirements.

X1 9. [redacted] confirmed a previous verbal agreement that the completed optical design would be submitted by NPIC to our optical consultant, [redacted] 25X
X1 [redacted] for evaluation. This verbal agreement should be confirmed in writing by the contracting officer.

ATTACHMENT J

70X

FRACTIONAL APERTURE HEIGHT

-1.0 -.8 -.6 -.4 0 .4 .6 .8 1.0

CENTER

CORNER

-.01

5.36

5.37

5.36

7.21

7.20

7.19

7.18

7.17

FILM GATE HEIGHT (MM)

25-70x Zoom

KEUFFEL & ESSER CO.

FRACTIONAL APERTURE HEIGHT

-1.0 -.8 -.6 -.4 0 .4 .6 .8 1.0

AXIAL

EDGE

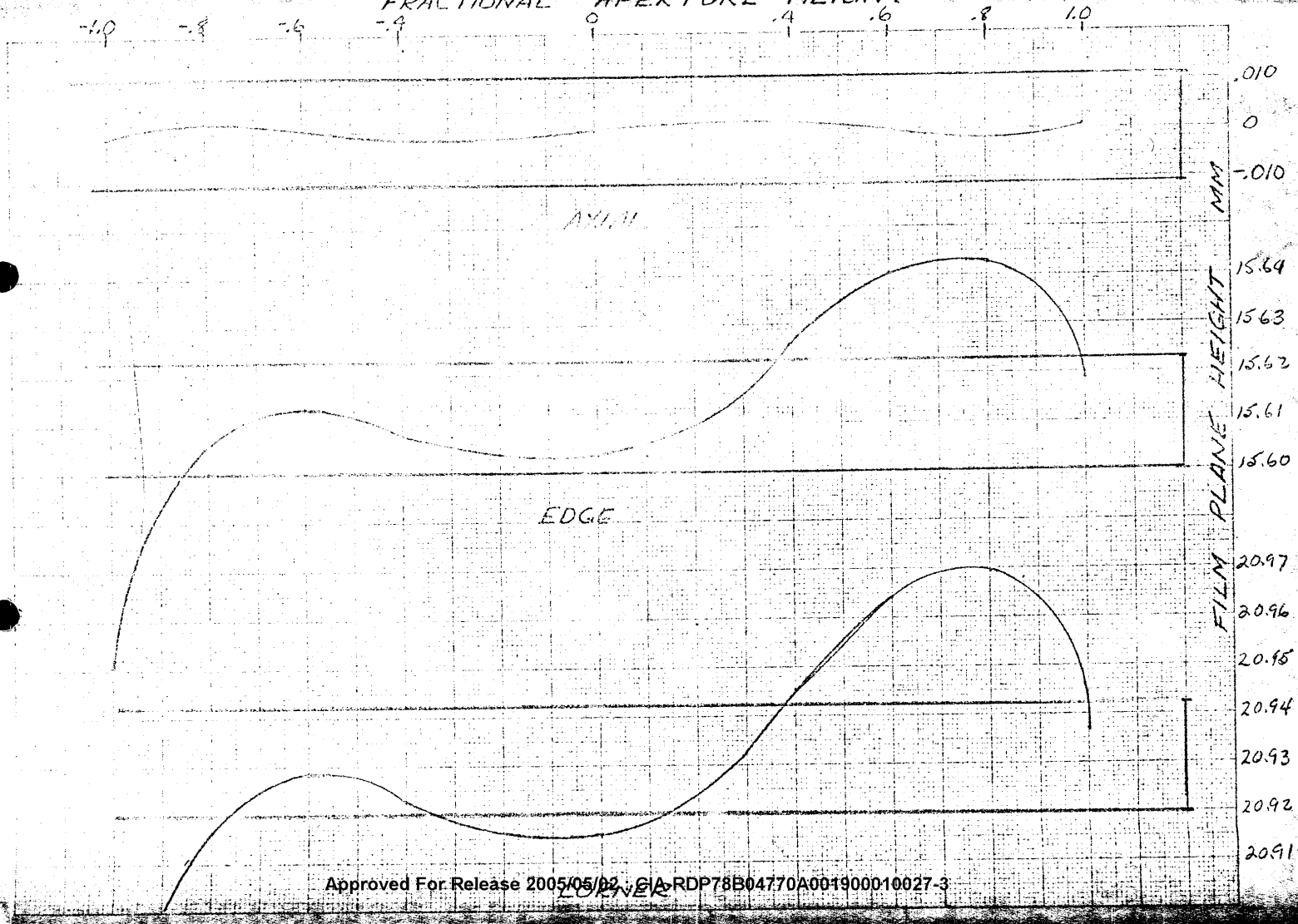
CORNER

IMAGE PLANE HEIGHT mm

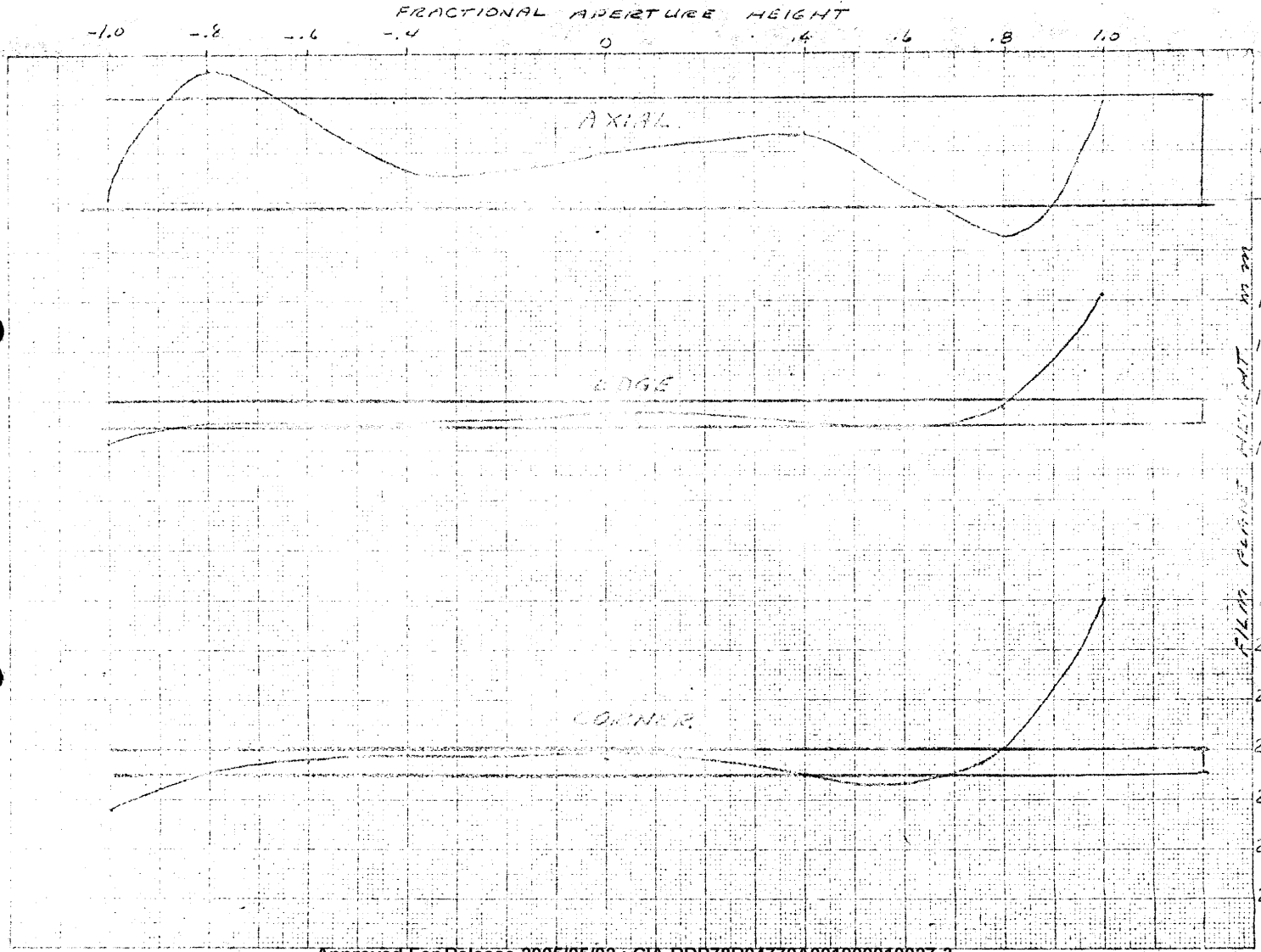
.010
0
-.010
9.17
9.16
9.15
9.14
9.13
12.2
12.2
12.2
12.2
12.2

24 X

FRACTIONAL APERTURE HEIGHT



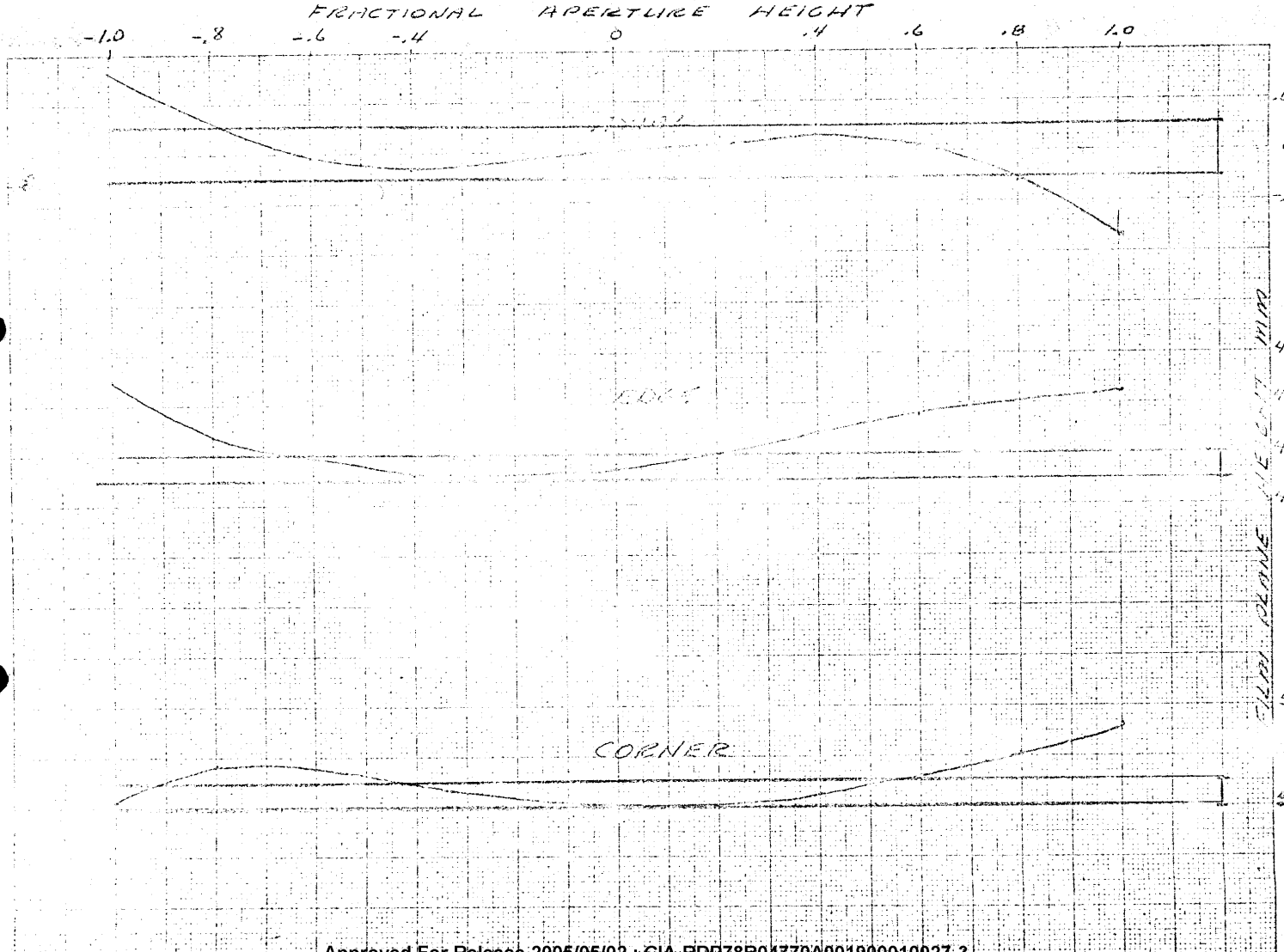
LOWER



3X-30X 200m

9.5X

9/22/67



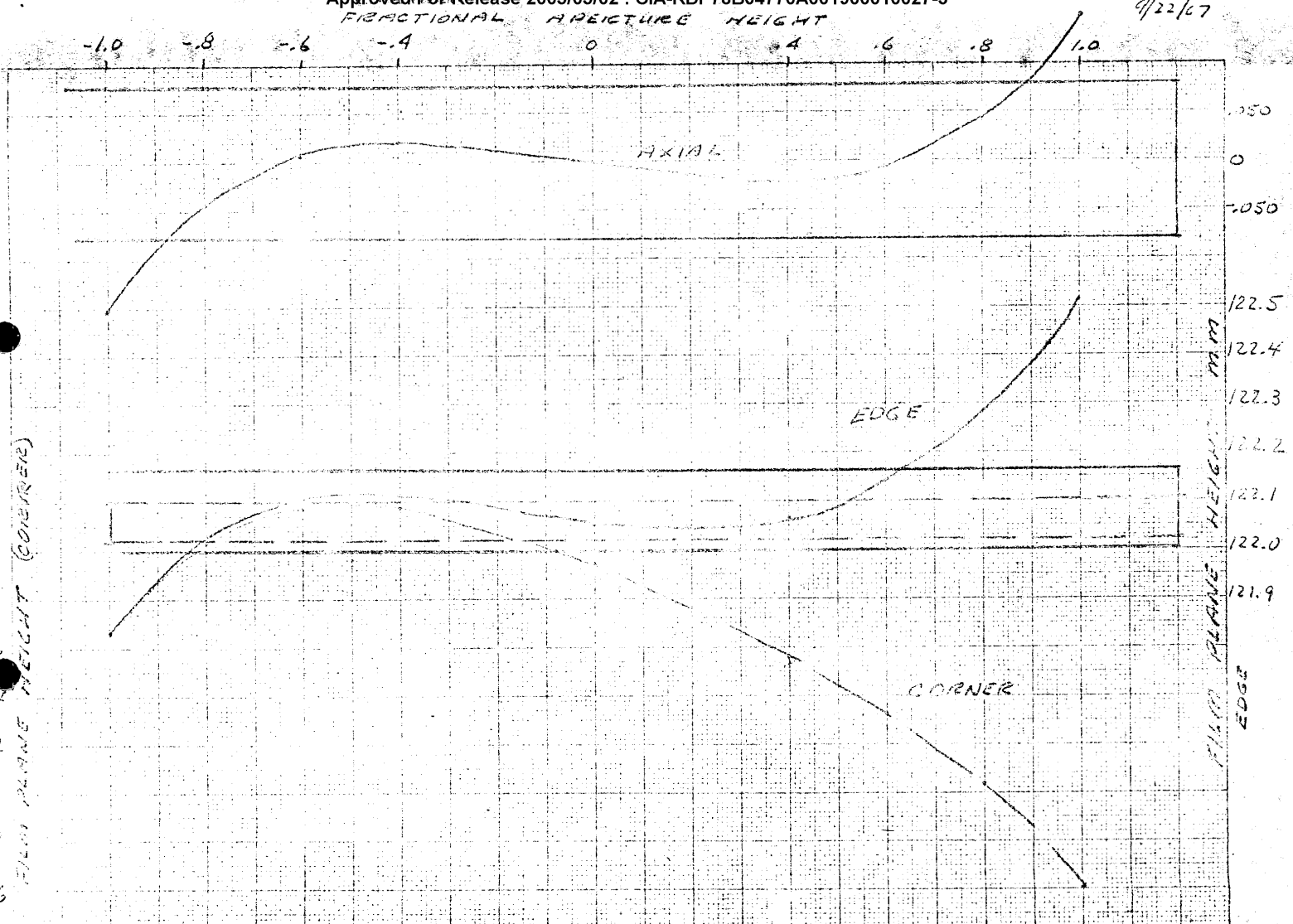
3-30X ZOOM

9/22/67

FRACTIONAL APERTURE HEIGHT

3X - 30X Zoom

9/22/67



3-30x ZOOM

HUMAN FACTORS STUDY
ADVANCED REAR PROJECTION VIEWER

OBJECTIVE

The objective of this report is to present the results of a study conducted to produce a configuration, based solely on human factors considerations, for the advanced, rear projection viewer.

METHOD

The study consisted of three major phases:

1. Preparation of a description of the interpreter's functions and tasks when using the advanced rear-projection viewer.
2. Establishment of a set of human factors design goals aimed at providing optimum man/machine interfaces for the performance of the identified functions and tasks.
3. Development of a configuration based on the design goals.

RESULTS

Description of Interpreter Tasks and Functions

It is important to note that with respect to the viewing equipment, the term "scan" means a specific, formalized operation. The results of this operation are principally to catalogue the quality of coverage for known targets located on the film and secondly, to report new targets. The cataloguing (which is called "indexing") is by far the most time consuming of the two activities even though the finding of the new targets is probably the most important. It is not unusual for a given mission to have the new targets number only a fraction of one percent of the old targets.

From the standpoint of the viewing equipment's acceptability by the operational personnel, the equipment must facilitate the "indexing" portion of the "scan." It should be noted that the "indexing" task is almost universally disliked and the operational personnel will be very sensitive to any equipment feature which makes the task more difficult; however, they will be equally sensitive and appreciative of any equipment which takes the drudgery from the task. Further, decreasing the effort required for indexing increases the time permitted for locating new targets.

 ATTACHMENT 2

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In the Design Goals Section and the Flow Chart which follow, the term "collateral material" has been used to cover material used for indexing as well as for finding new targets.

Figure 1 is a generalized functional flow diagram of the scan function performed on the advanced rear projection viewer. The purpose of the flow is to identify, in a systematic way, those functions which have particular significance for design of the interpreter/machine interface.

Design Goals

The design goals presented below are identified with the function from the flow chart which generated them. Only those goals peculiar to the advanced rear projection viewer have been considered. Items having to do with normally sound human engineering practice, such as the layout of controls and displays and the rounding of corners to prevent injury to the operator, have not been detailed in this report.

FUNCTION 1.5—Place image in desired position on screen

1. Masking should be provided along edges of film to prevent excessive illumination on portions of the screen when areas near the edges are positioned in the center of the screen for viewing.

FUNCTION 1.6—Scan full screen

1. Viewing angles obtainable for entire screen should be as near normal to the screen as possible to reduce brightness loss to a minimum.
2. Viewing distances for the entire screen should be as near 14 inches minimum as possible for comfortable viewing.
3. Viewing angle for any portion of the screen should not impose awkward or uncomfortable postures or head positions.

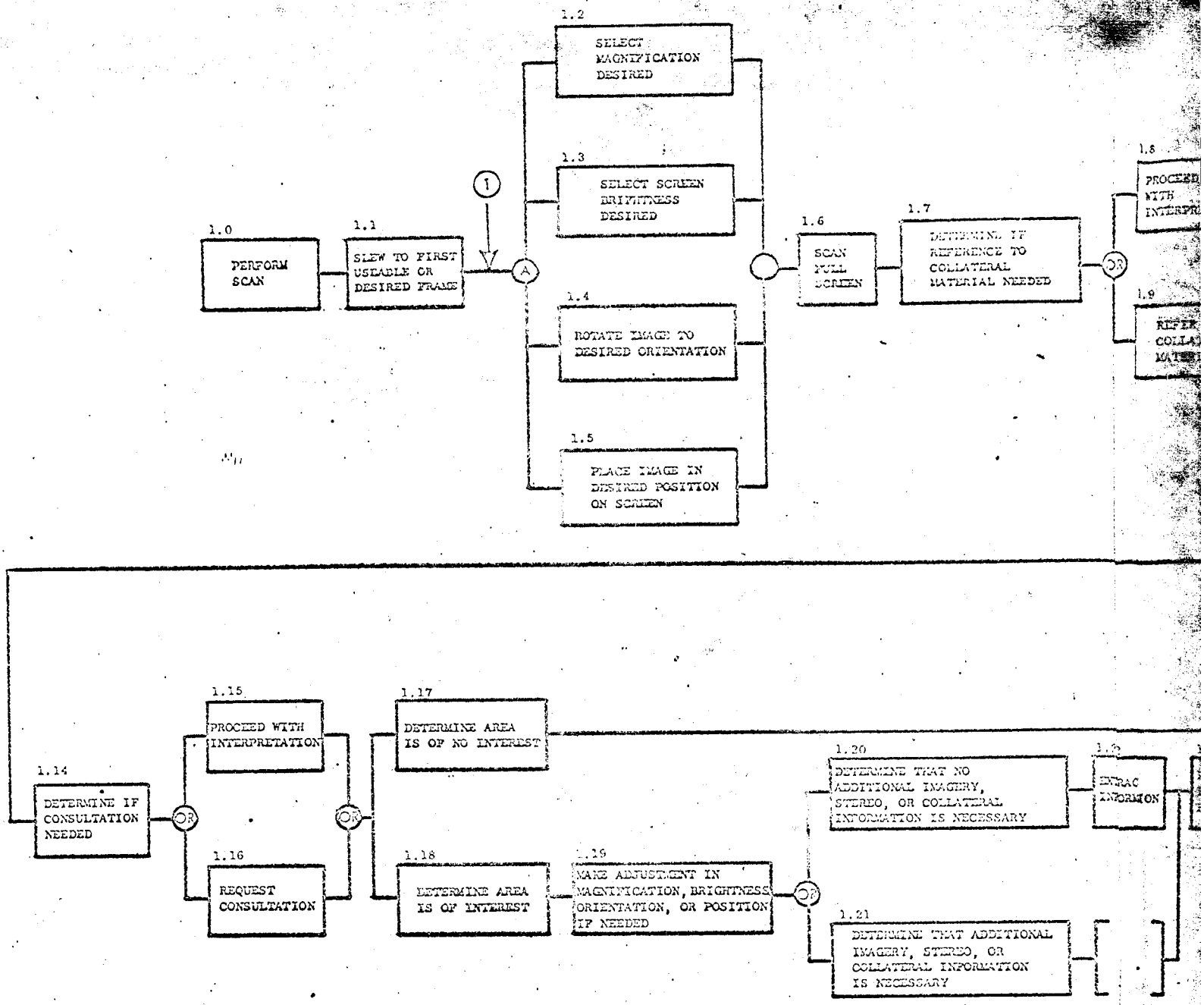
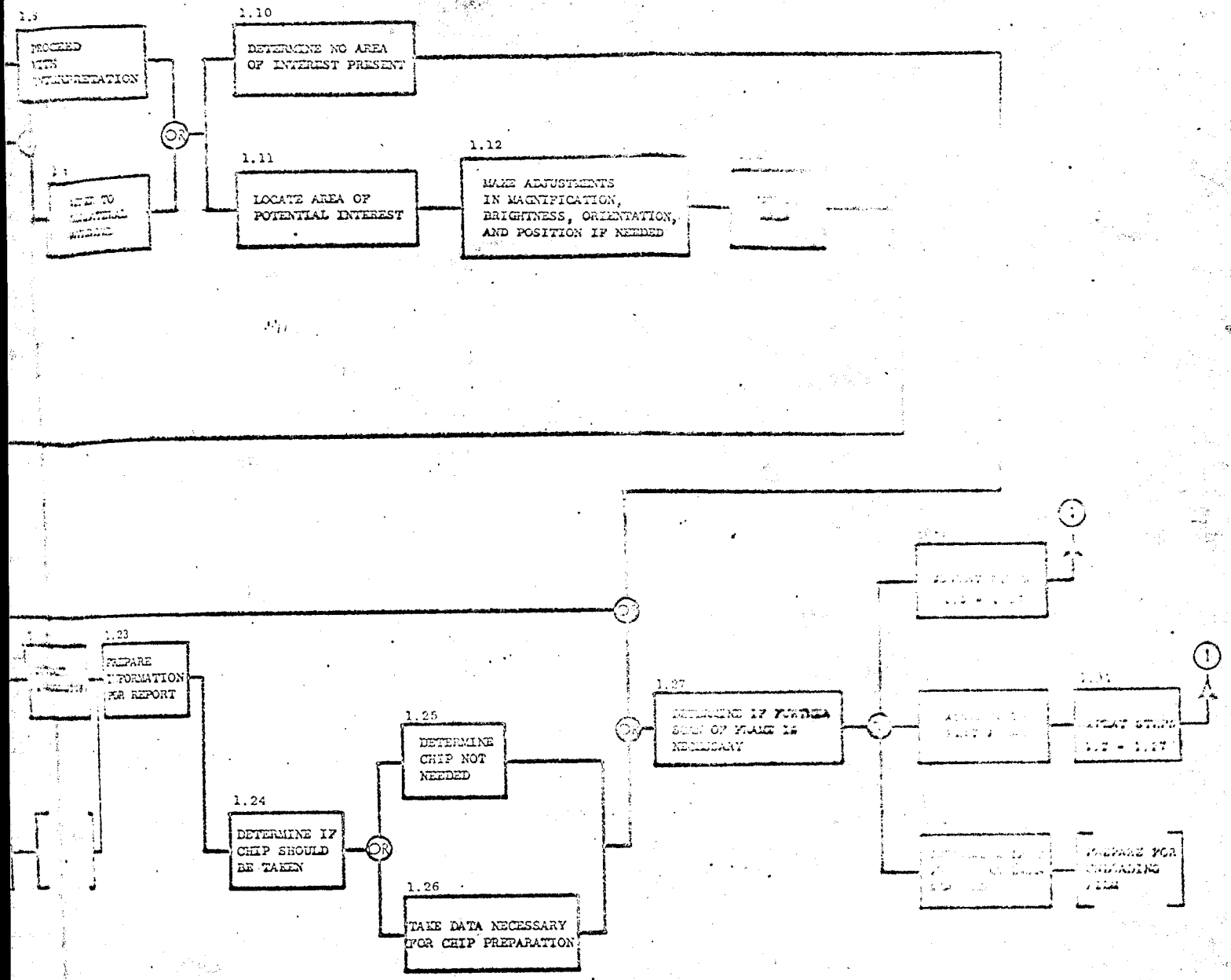


FIGURE 1. FUNCTIONAL FLOW DIAGRAM



ILLEGIB

FUNCTION 1.9—Refer to collateral material

1. Reference to collateral material should not require major shift of position.
2. Area provided for collateral material should be large enough to allow systematic viewing of material.
3. Area provided for collateral material should allow for convenient viewing of maps without restriction on map orientation.
4. Area provide for collateral material should allow for convenient, organized storage of material not in immediate use.
5. Viewing screen material and orientation should allow placement of collateral material on the screen for side-by-side comparison with projected image.

FUNCTION 1.11—Locate area of potential interest
and 1.22—Extract information

1. Viewing arrangement should allow interpreter to make use of all information on the imagery without placing film in a different piece of equipment.

FUNCTION 1.16—Request consultation

1. Work station design should allow convenient viewing of screen by at least two people simultaneously.
2. Collateral material area should allow convenient selection of material for viewing by any one of three people.
3. Work station design should not require major displacement of operator when consultant is present.

FUNCTION 1.23—Prepare information for report

1. Area provided for report preparation should be large enough to allow systematic arrangement of report materials.
2. Area provided for report preparation should be large enough to permit writing material to be oriented in a normal, comfortable manner.

3. Area provided for report preparation should be located so that no ma or shift of body position from viewing posture is required.
4. Area provided for report preparation should have convenient storage for report preparation materials such as pencils, paper clips, staplers, etc when they are not in use.

GENERAL

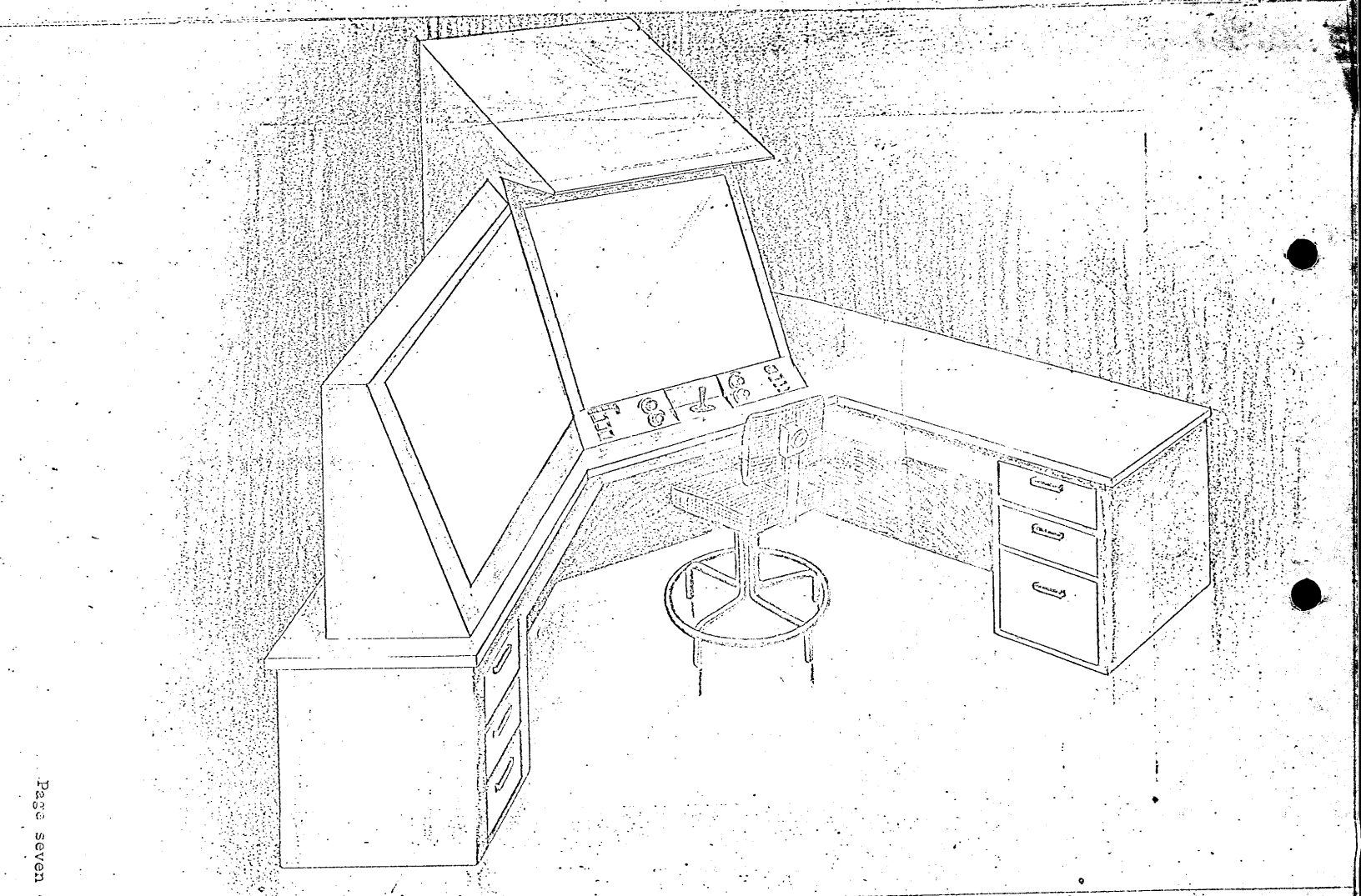
1. Viewing screen should not be damaged or broken by inadvertent bumping with operator's hands, elbows or with collateral material.
2. Work station should provide convenient place for ash trays, coffee cups, and operator's personal equipment such as scales, loupes, and glasses.
3. Work station should be designed to prevent damage to equipment or materials and spilling of ash trays, coffee and soft drinks.
4. Ease of film loading and unloading is critical. While provisions for long rolls of film must be made, it is normal in the scanning operation to have rolls which are quite short (as few as four frames in a roll). For this reason, frequent handling of rolls is required.
5. Provision for handling small film chips encased in plastic sleeves would greatly increase the flexibility of the viewer.

Configuration

The configuration which most nearly satisfies the design goals is one which will allow a sit-stand type of operation such as that performed at a drafting table. A sketch of the suggested configuration is shown in Figure 2. This configuration was chosen over one using standard office seating for several reasons.

1. In order to prevent awkward and uncomfortable viewing positions. For a 30 x 30 inch viewing screen, it is necessary to have the top sloping away from the interpreter (face of the screen tilted up). Figure 3 illustrates the angles of gaze for three screen orientations: (1) face of the screen tilted down 15° (top sloping toward the operator); (2) vertical; and (3) face of the screen tilted up 15°. For example if the operator can be positioned at a viewing distance of 14 inches so that his line of gaze is normal to the screen at the midpoint of the screen height, to see the top one third of the screen when it is tilted face downward 15°, he will have to direct his gaze upward between 50 degrees and 60 degrees. In the same situation, if the screen is tilted face upward 15°, his gaze will only be between 20 to 30 degrees upward. Since working for even short periods of time with the head tilted backwards is extremely likely to produce fatigue and accompanying discomfort symptoms in the back of the neck, the reduction obtainable by orienting the screen 15° face-up is very desirable.

2. In the 15° face-up configuration, if the height of the center of the screen is set for a normal viewing condition for a 50 percentile operator (line of gaze normal to the screen, viewing distance 14 inches) the bottom of the control panel, or writing surface will interfere with the thighs of the 95 percentile operator (assuming a 6-inch high control panel). If the screen is raised to accommodate the large man's thigh clearance, the viewing angles are significantly increased for the 5 percentile man. This has the undesirable effect of



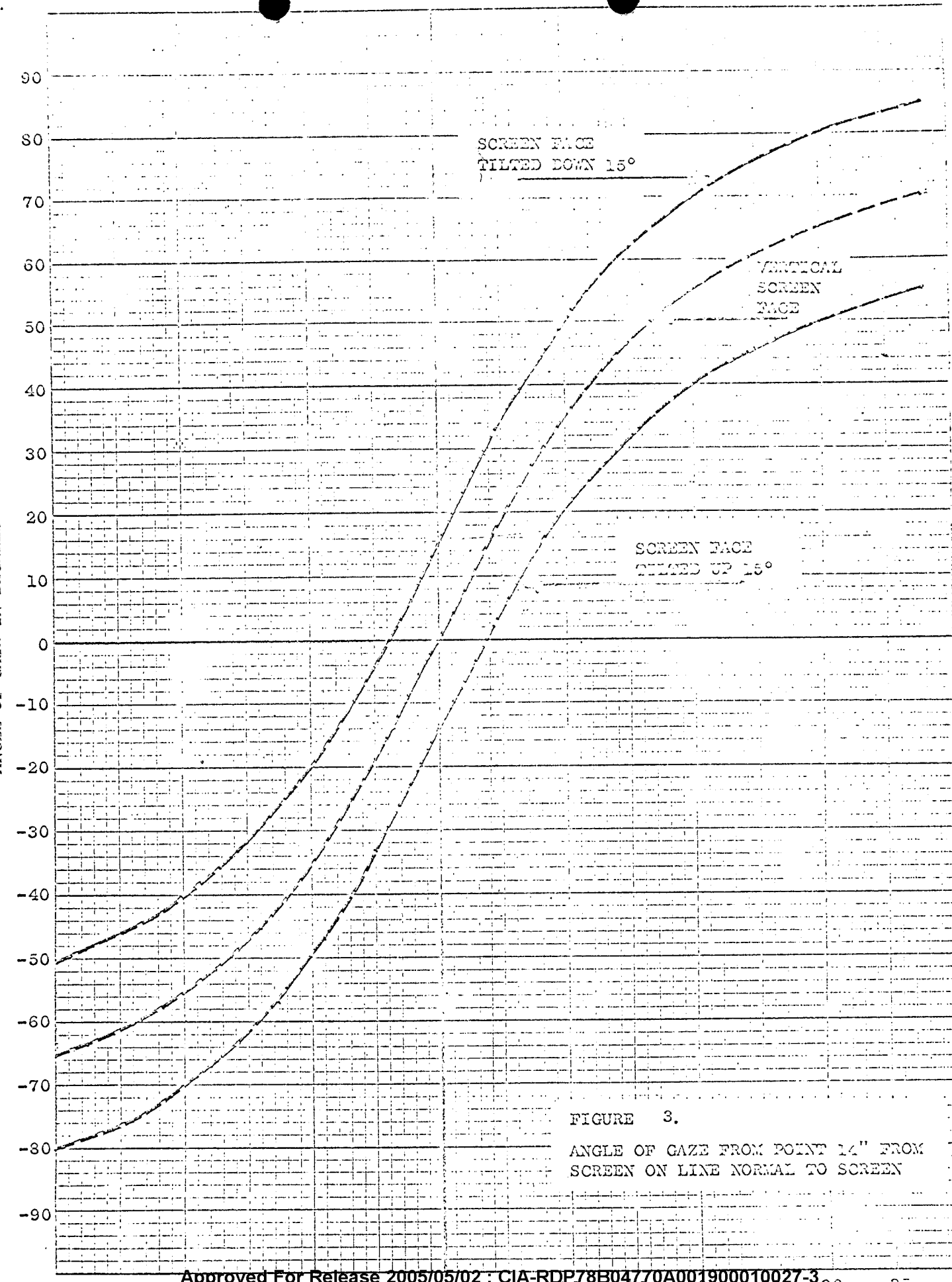


FIGURE 3.

ANGLE OF GAZE FROM POINT 14" FROM SCREEN ON LINE NORMAL TO SCREEN

increasing the angle of gaze above horizontal, which is itself, undesirable, and which has the additional drawback of reducing the brightness of the image reaching the interpreter's eye. Figure 4 illustrates the gain for Polacoat LS-60C at various viewing angles. These gains were converted into percentages, which are shown in Figure 5. Figure 6 shows this data plotted as a function of the location of the screen's surface with respect to the eye's position. Information is shown for two conditions; first, when the eye is fixed at a point 14 inches from the screen measured on a line normal to the screen, and second, when the eye moves at a constant height and maintains a viewing distance of 14 inches to the point to be observed on the screen. As can be seen from the curves, placement of the operator 4 inches below his optimum height (line of sight normal to the screen, passing through the midpoint of the screen) reduces the brightness at the center of the screen by 30 to 35 percent and for the top third of the screen by more than 50 percent.

3. The height for a sit-stand configuration with a screen in the 15° face-up configuration can be such that people standing and consulting with the interpreter can have a good view of the screen. Figure 7 shows a side view sketch of the viewer. The screen centerline height of 53.4 inches is based on a consideration of the following dimensions:

Seat height	27 inches
Thigh clearance	7 inches
Shelf thickness	1 inch
Control panel	4 inches
Height to screen Center	14.4 inches
TOTAL	53.4 inches

To arrive at the ideal operator's eye height from the 53.4 inches at the center of the screen, 3.6 inches must be added. This is the height above a point on the screen at which the eye must be in order to have a line of sight normal to the screen

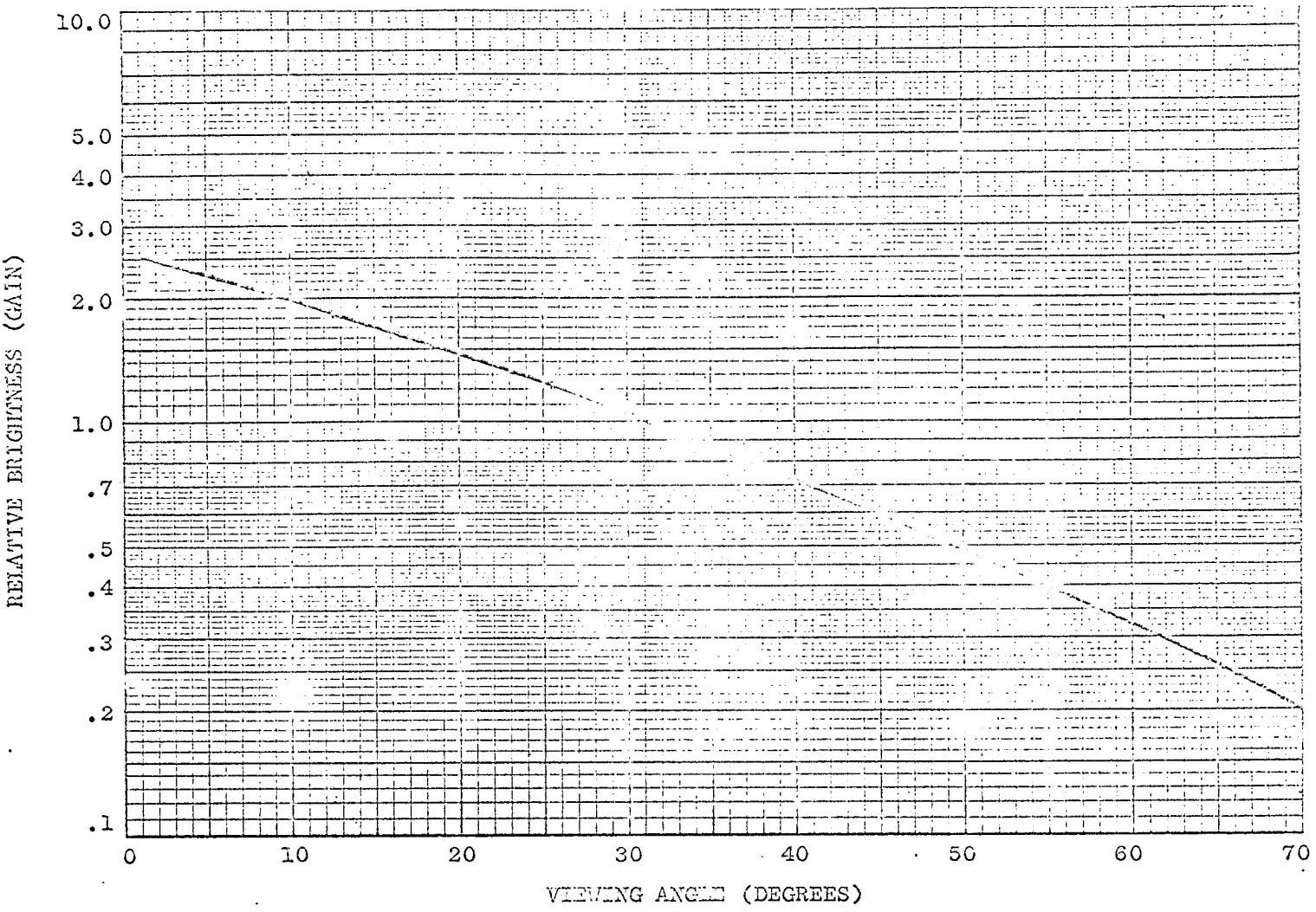


FIGURE 4. VIEWING ANGLE IN DEGREES FROM CENTRAL AXIS (FOR POLACOAT LS-60C)

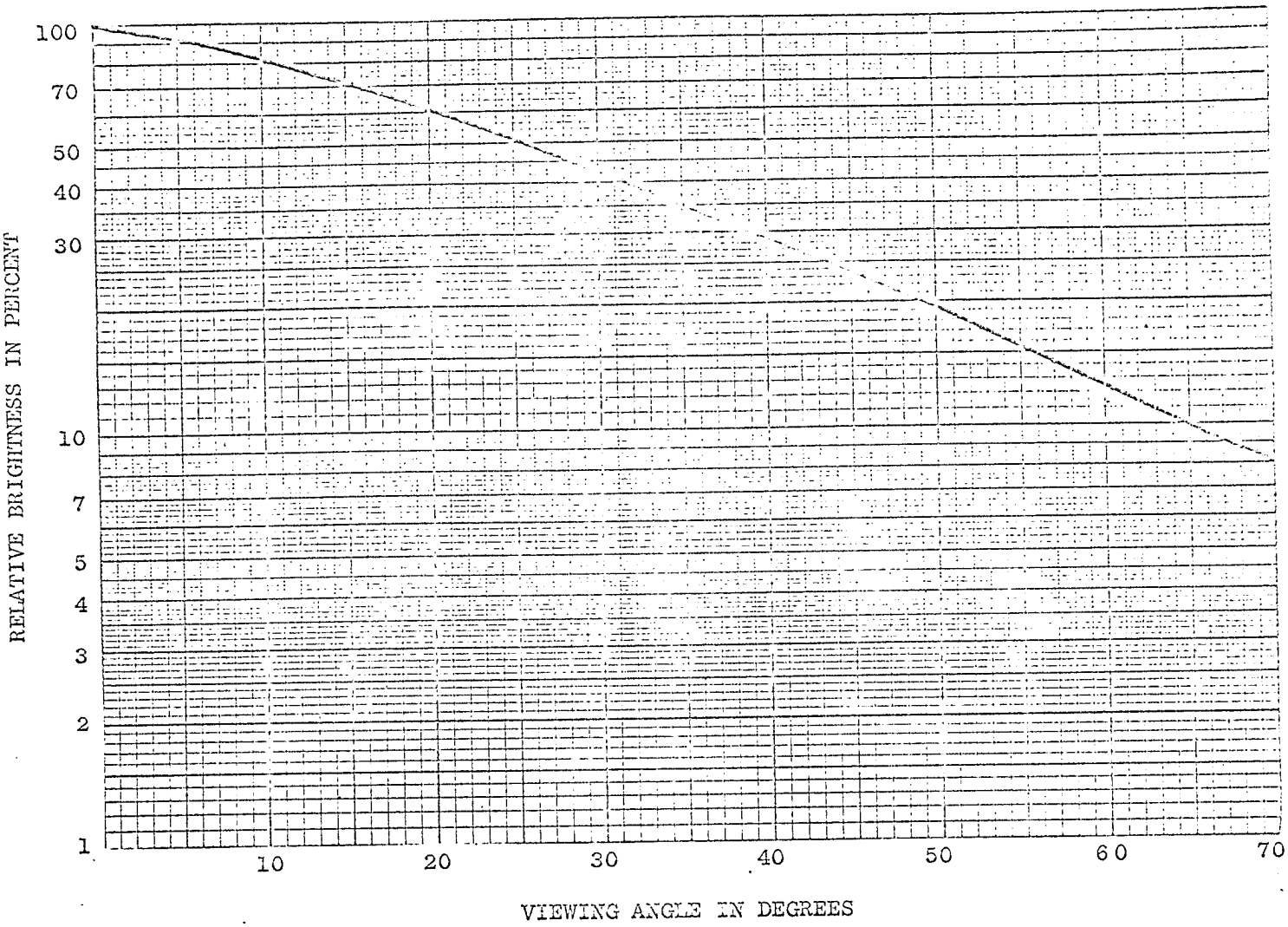


FIGURE 5. RELATIVE BRIGHTNESS IN PERCENT AS A FUNCTION OF VIEWING ANGLE FOR POLACOAT LS-60C

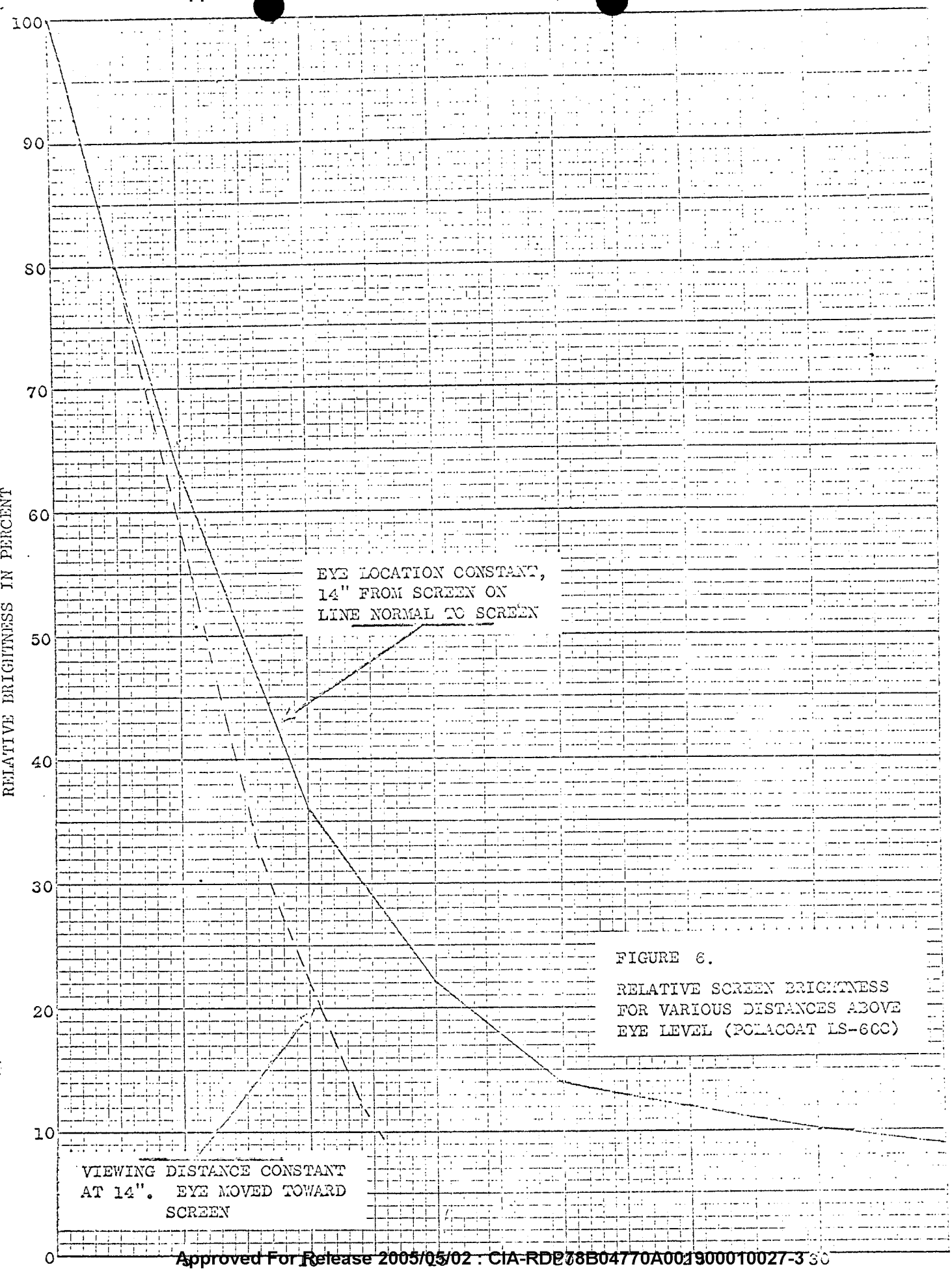


FIGURE 6.

RELATIVE SCREEN BRIGHTNESS FOR VARIOUS DISTANCES ABOVE EYE LEVEL (POLACOAT LS-600)

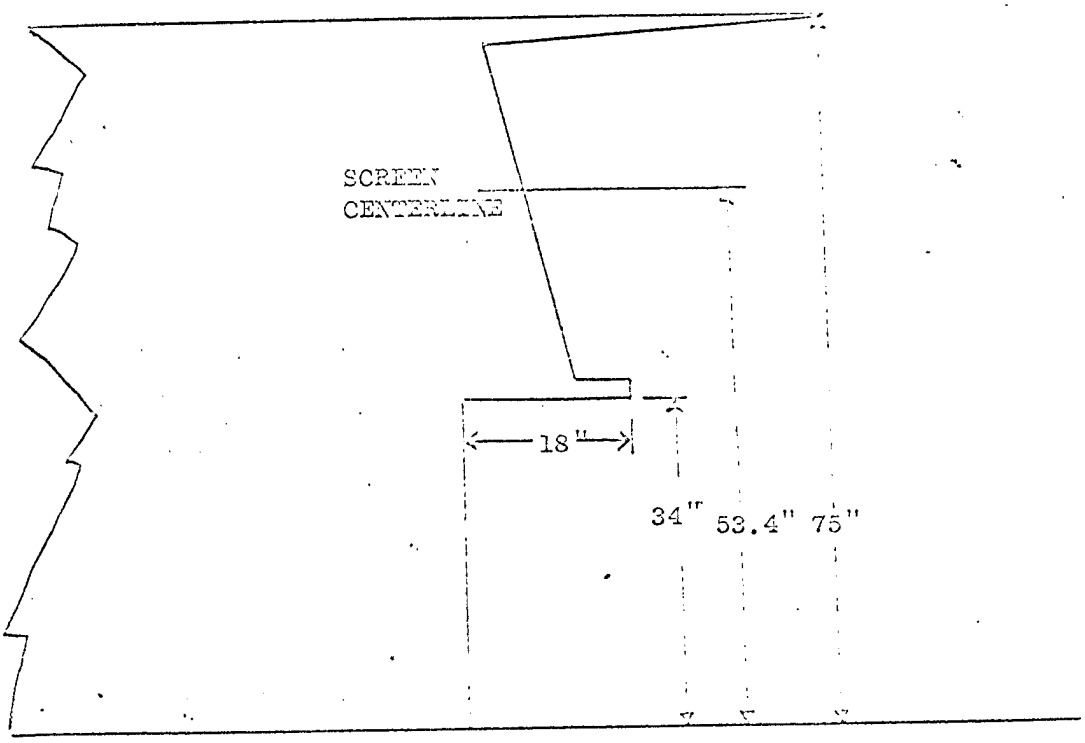


FIGURE 7. SIDE VIEW OF PROPOSED REAR PROJECTION VIEWER CONFIGURATION

at a 14 inch viewing distance. The ideal eye height for the 50 percentile operator should therefore be 57 inches. The actual eye height for a 50 percentile man seated on a 27-inch stool will be 56.5 inches, allowing for a normal 2 inch slump in sitting height. Figure 8 give the anthropometric data used in this study.

With a seat height of 27 inches, a foot rest must be provided which is adjustable through a range of 6 to 12 inches above the floor.

4. The 15 degree face-up configuration of the screen will allow the interpreter to place collateral material on the viewing surface to provide side-by-side comparisons with the information on the screen.

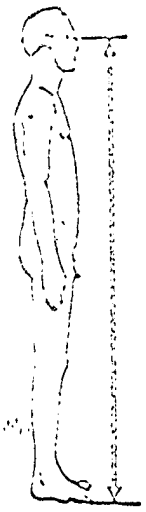
5. As shown in Figure 2, a large area is provided to the left of the operator for placement of collateral material at the same height and angle of the screen. This material will also be readily available to other interpreters during the consultation process.

6. A desk area is provided to the right of the screen (Figure 2) to provide a suitable writing surface and to allow viewing of collateral material that is not suited for the sloping board to the left of the screen. Desk-type storage space is provided on both extensions.

7. Consideration should be given to providing for direct viewing of the film through the optical system. An auxiliary lens system which could be mounted over a clear area of the screen would be the ideal way to provide for this from a human factors standpoint.

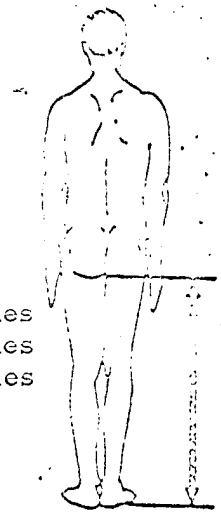
   Such a provision should greatly increase the flexibility of the viewer, allowing film viewing without the contrast or resolution loss of the screen. It should also significantly improve the interpreter's acceptance by providing him with nothing but "clear glass" between himself and the film.

STANDING EYE HEIGHT



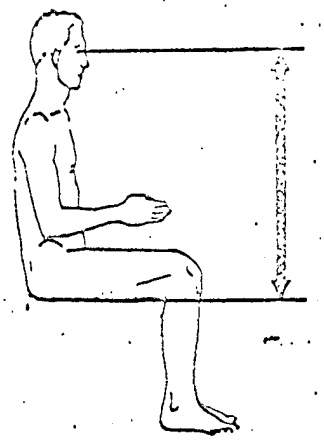
5%ile	60.8 inches
50%ile	64.7 inches
95%ile	68.6 inches

GLUTEAL FURROW HEIGHT



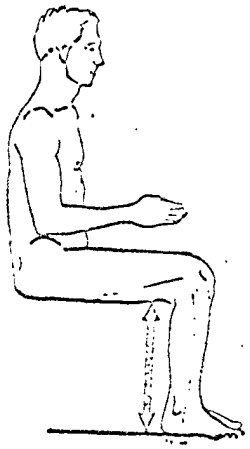
5%ile	29.8 inches
50%ile	31.6 inches
95%ile	34.3 inches

EYE HEIGHT ABOVE SEAT REFERENCE POINT



5%ile	29.4 inches
50%ile	31.5 inches
95%ile	33.5 inches

HEIGHT TO SEAT REFERENCE POINT



5%ile	15.7 inches
50%ile	17.1 inches
95%ile	18.2 inches

FIGURE 8. ANTHROMPOMETRIC DATA

(From Hertzberg et al., 1954)